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DAVID FERGUSON'S MINERAL PROSPECTING EXPEDITION TO SOUTH GEORGIA IN 1912

by

Phil Stone and John Faithfull

The mineral exploration work in the Falkland Islands by the Scottish geologist and mineral prospector David Ferguson, during the 1913-1914 austral summer, was described in the 2013 issue of Falkland Island Journal (Volume 10, Part 2). But that was Ferguson's second expedition to the South Atlantic region on behalf of the Christian Salvesen Whaling Company. During 1912 he had visited South Georgia to assess the rocks there for the possible presence of economic minerals.

When the Salvesen Company established their onshore whaling station in Stromness Bay in 1909, naming it Leith Harbour after the company's home port in Scotland, negotiations for mineral rights were promptly begun with the Falkland Islands Government (at that time South Georgia was a Dependency of the Falkland Islands). These were successfully concluded and a formal license allowing prospecting was signed on 31 May 1911 by the Governor of the Falklands, William Allardyce. A copy of the license is preserved in the Salvesen Archive, now held by the University of Edinburgh Library's Centre for Research Collections, along with other material relevant to Ferguson's survey including his geological report and some of his photographic prints and glass-plate negatives.

A biographical summary for David Ferguson (1857-1936) was given in the previous Falkland Island Journal article. When recruited by Salvesen he had a wealth of mineral prospecting experience and had studied geology at the University of Glasgow. There he made the contacts with the University scientists Professor J. W. Gregory and Dr. G. W. Tyrrell that led to their collaborative interpretation of his South Georgia survey results. The three men published scientific papers describing the geology of South Georgia jointly in the *Geological Magazine* for 1914, and as a series of individually authored papers in the *Transactions of the Royal Society of Edinburgh* for 1915. Curiously, although Ferguson did not visit the Falkland Islands until the following year, what he already knew of their geology was to prove influential for his South Georgia interpretations.

Ferguson's collection of rock specimens from the South Atlantic region was presented by the Salvesen Company to the University of Glasgow in 1915. The University's Hunterian Museum now holds about 200 'Ferguson' specimens from South Georgia, although some of them were collected by Salvesen employees subsequent to Ferguson's visit, but at his request, to illustrate parts of the island that

he was unable to examine. In addition to the specimen collection held by the Hunterian Museum, the University of Glasgow Archive Services hold Ferguson's field notebooks. The South Georgia notebooks, like their Falkland Islands counterparts, are fragile, faded and water-damaged in places, and only came to light in 2003, when they were passed to the University from the Bank of Scotland archive where they had been held since Ferguson's death in 1936; presumably the Bank had been involved in the disposal of his estate.

Two notebooks relate to Ferguson's South Georgia survey and have the University Archive numbers 2500/27:UGC/176/3/1 and 2500/28:UGC/176/3/2. Notebook 1 is dated between 7 January and 12 February 1912; notebook 2 duplicates some of the entries between 30 January and February 3, has entries for February 8 and 11, and then continues until Ferguson's departure from South Georgia on 19 April 1912, with a few additional notes added later in July 1912. The notebooks provide a fascinating insight into the development of Ferguson's geological interpretations and add considerable value to his specimen and photograph collections. Also relevant to the 'Ferguson in South Georgia' story is a series of letters that he wrote to William Speirs Bruce, leader of the 1902-1904 Scottish National Antarctic Expedition (SNAE), that are now held by the Scott Polar Research Institute, Cambridge. Bruce's replies have not survived but it is clear that he took a keen interest in Ferguson's work and that the two men discussed the possibility of including Ferguson's description of the geology of South Georgia (which Bruce's expedition did not visit) in the SNAE report series that Bruce was then editing. In the event, this did not happen.

Ferguson sailed south on the Salvesen supply ship *North Sands*, and arrived at South Georgia on 7 January 1912. The voyage had clearly not been a happy one and the experience initiated the antipathy to Norwegian whalers that was to become so pronounced the following year in the Falkland Islands. Comments from notebook 1, written on 11 January 1912 at Leith Harbour, are revealing. Quite apart from bemoaning the monotony of the voyage and the general discomfort, Ferguson wrote:

"The piling up of 6 stories of empty oily barrels on deck, the placing of ¼ ton of explosives on several of the top row of these barrels, abaft the funnel, and the general want of order and discipline among the Norwegian passengers have been a menace to safety during the whole passage … Some day there will be a fire on one of these ships, and not a soul will escape in safety, as the ship is a death trap."

Geological work in South Georgia

From a base in the Manager's house at Leith Harbour, Ferguson was transported around the island, mostly by the whalecatcher *Matilda*, landing wherever possible to make observations and collect rock specimens. By good fortune, a splendid group

photograph showing Ferguson surrounded by the crew of the *Matilda* (Figure 1) is amongst the glass-plate negatives preserved in the Salvesen Archive. It is the only image of Ferguson known to exist – but from the look of the crew there was not much fun to be had on a whalecatcher!

Figure 1. David Ferguson (seated, centre) surrounded by the crew of the S.S. Matilda*, the whale catcher that transported him around South Georgia. Grytviken, March 1912. Reproduced with permission from Edinburgh University Library, Special Collections Department. Salvesen Archive image reference 7628d.*

The outline geology of South Georgia is shown in Figure 2. Much of the island is underlain by a thick succession of Lower Cretaceous (ca 120 million years old) volcanic-derived sandstone and mudstone (**Cumberland Bay Formation**), asymmetrically folded and thrust towards the north east to structurally overlie a more intensely deformed and cleaved succession of quartzose strata (**Sandebugten Formation**), which may nevertheless be of a similar Cretaceous age. A major shear zone separates these and broadly similar (but more deformed) sedimentary rocks (**Cooper Bay Formation**) from a very different lithological assemblage that forms the south-east part of the island: gneiss intruded by ca 160 million years old granite (**Drygalski Fjord Complex**), Upper Jurassic (ca 150 million years old) lavas (**Larsen Harbour Complex**) and Lower Cretaceous volcano-sedimentary rocks (**Annenkov Island Formation**). Of the approximately 200 'Ferguson' specimens from South Georgia in the Hunterian Museum collection, the great majority (and all

of those that he collected personally) are from the Cumberland Bay and Sandebugten formations.

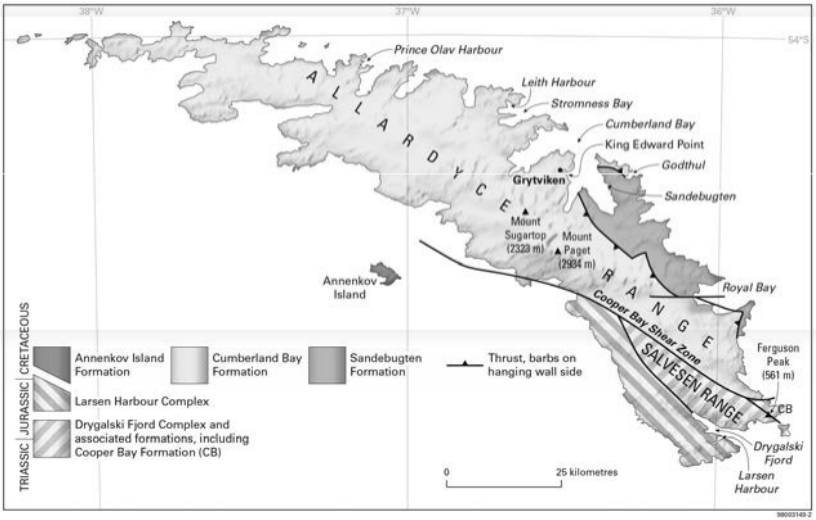

Figure 2. A simplified geological map of South Georgia after Curtis, M. 2011. British Antarctic Survey GEOMAP 2 Series, Sheet 4.

During his time on South Georgia, Ferguson was not able to land at the south-east end of the island so did not see the igneous rocks at first-hand. It is clear from his notebook entries that he was initially inclined to doubt their presence but the specimens collected subsequently, and passed on to him, corrected that view.

At the time of Ferguson's visit the geology of South Georgia was only poorly known. Some observations had been made by the German International Polar Year Expedition (1882-1883) and the Swedish Antarctic Expedition (1901-1903) whilst only a month before Ferguson arrived, Filchner's German South Polar Expedition had departed, heading south. Filchner's expedition had added considerably to the geological knowledge of the islands and although Ferguson would have known nothing of the detail of their work, he picked up some information on their findings from staff at the whaling stations. A thick sedimentary succession of sandstones and mudstones clearly formed most of the island and was locally much deformed, with granite and other igneous rocks reported from the south-east end. Ferguson was shown a sketch of a fossil discovered by the Germans, a poorly preserved ammonite indicating a relatively young (in geological terms), Mesozoic age. This age has now been definitively confirmed by a number of more recent finds, but was prematurely dismissed by Ferguson even though he noted (but misidentified) a similar fossil himself at Prince Olav Harbour.

Ferguson also found fossilised traces of “annelid or worm burrowing” and what he thought were plant fossils, more specifically the impressions of marine algae or ‘fucoids’. This interpretation was rather out-of-date. In the mid-Victorian era, 'fucoids' were thought to be seaweed impressions (and so were named after the present-day genus *Fucus*), but around 1860 the British palaeontologist J. W. Salter protested that the features were more likely to be the foraging traces of marine animals. It took some time for the revised opinion to be generally accepted, but it is surprising that Professor Gregory, an eminent palaeontologist, should still refer to “plant-like impressions which are conveniently regarded as fucoids” when describing Ferguson’s fossils.

Although Ferguson noted and photographed folded strata at numerous localities, the implications of such deformation were largely ignored in the geological map and cross-section that he constructed (Figure 3).

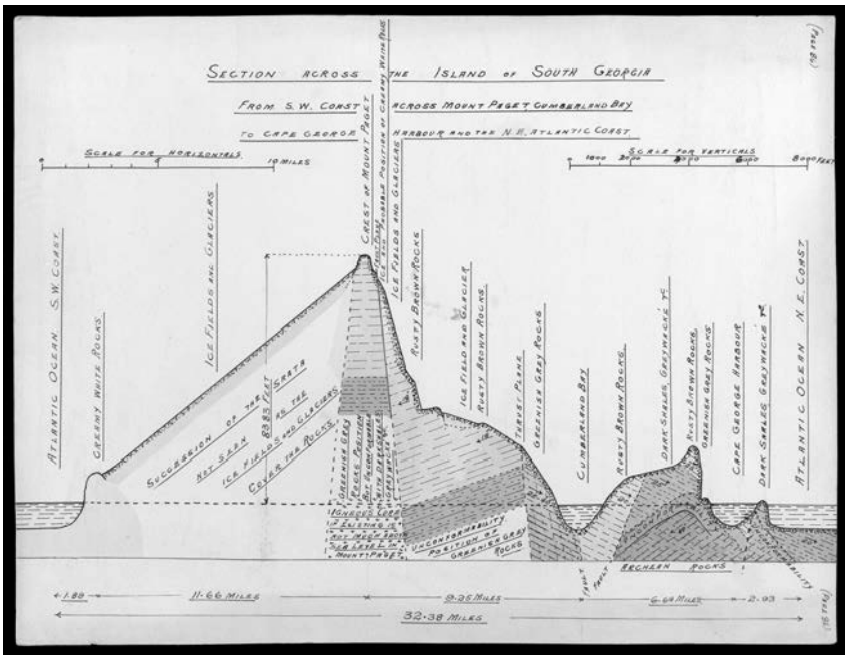

Figure 3.The geological cross section of South Georgia drawn up by Ferguson and included in his (unpublished) confidential report to the Salvesen Company. Reproduced with permission from Edinburgh University Library, Special Collections Department. Salvesen Archive reference Gen 1925, H34, image reference 25480d.

Instead, Ferguson saw the sedimentary succession as a conformable series of three divisions, which he differentiated largely on the basis of colour. In one relatively small area of the island, around Godthul, he thought that the middle division lay unconformably on very much older sedimentary strata with a more complex structural history. These supposedly older rocks appeared to him to have an unusually "archaic, indurated and gnarled look", but subsequent investigations have not agreed, with the observed effects now explained by variations in the local intensity of deformation having been juxtaposed by fault movements. Ferguson was characteristically confident of his interpretation, but his reliance on colour for correlation led to some unlikely results. In his structural cross-section of the island's geology (Figure 3) he envisaged a core of ancient rocks with a sedimentary cover that was progressively faulted down to either side, but was only locally affected by the extensive folding of the strata, spectacular examples of which he saw and photographed, for example on the Busen Point cliffs of Stromness Bay (Figure 4).

Figure 4. Large-scale folding of the strata seen in the cliffs of Busen Point, the south-east headland of Stromness Bay. The highest point on the skyline ridge is about 400 m above sea level. Photograph by Kim Crosbie.

It did not take long for the errors inherent in that approach to be pointed out. Shackleton's ill-fated *Endurance* expedition called at South Georgia in November 1914 and the expedition's geologist, J. M. Wordie (curiously, another of Gregory's protégés) noted the same spectacular folds in Stromness Bay. Writing later, in the *Transactions of the Royal Society of Edinburgh* for 1921, Wordie dismissed

Ferguson's "unfortunate attempt at subdividing the sedimentary series" as entirely misconceived.

Wordie was not the only member of the *Endurance* expedition to take note of the large-scale, Stromness Bay folds in November 1914. Eighteen months later, as Shackleton, Worsley and Crean completed their epic trek across South Georgia after sailing the *James Caird* from Elephant Island, they spotted the same structures in the distance. At that sight Shackleton wrote in *South*, "Without a word we shook hands with one another. To our minds the journey was over."

The preconceptions that fatally undermined Ferguson's attempts to interpret the geology of South Georgia originated in Scotland. His predilection for the rocks being relatively ancient owed much to the influence of Professor Gregory who, in those days before the continental drift proposals of Alfred Wegener (coincidentally from 1912 onwards), interpreted the islands of the South Atlantic as the remains of a vast foundered landmass, relics that might, accordingly, very well be formed of ancient rocks. It is also clear from comments in his notebooks that Ferguson mistakenly compared the South Georgia rocks to similar-looking examples in Scotland with which he was familiar, and which are indeed relatively old. He was also influenced by the apparent similarity to the South Georgia rocks of specimens acquired for him from the South Orkney Islands by a whaling captain. Bruce's Scottish National Antarctic Expedition had erroneously reported an ancient fossil from those islands, again from rocks that subsequently proved to be much younger than supposed. As a result of these misconceptions, Ferguson precipitately dismissed sound evidence that his South Georgia rocks were much younger than he thought. A summarizing statement in notebook 2, written towards the end of his survey on 15 March 1912, claimed that "[t]he island is a fragment of a thickness of sedimentary rocks, in an old continental area". In his report to the Salvesen Company Ferguson went much further, writing (p. 54) of the old continental area: "it probably extends north of South Georgia and south of the South Orkneys for some distance. It is also connected with the Falkland Islands and the southern extremity of South America to the west, and to the east it is connected to the South Sandwich Islands. These island groups are mere fragments of a vanished land mass, which indicate to some extent its submerged position under the waters of the South Atlantic."

The mistaken regional model inherited from Gregory was clearly, in Ferguson's view, reinforced by what he knew of the geology of the Falkland Islands: strata there appeared to be less deformed than those of South Georgia and contained Devonian fossils (ca 405 million years old). This combination became significant when both the Falklands and South Georgia were regarded as contiguous parts of the same original landmass. In his report to the Salvesen Company (p. 56) Ferguson wrote: "The Falkland Islands are proved to be formed of rocks of Devonian Age. From all the information obtained from those who have seen them, and also the rocks of South

Georgia, the latter is the more ancient system. The sandstones of the Falklands are fine grained soft and yellow building stone, not to be seen among the rugged greywackes of South Georgia … [T]here is little doubt that the rocks of South Georgia are not later than Silurian, and may be anterior to it". The Silurian Period (ca 420-445 million years ago) immediately precedes the Devonian but, in fact, the Falklands rocks are considerably older than the mostly Cretaceous (ca 120 million years old) strata of South Georgia. The two areas have simply experienced very different geological histories.

With South Georgia interpreted as a relic of a foundered South Atlantic landmass, it was inevitable that Ferguson would expect large-scale faults to define the geological boundaries of South Georgia. The cross-section that he constructed (Figure 3) was drawn-up with that assumption as the primary governing feature. The version illustrated is the diagram that accompanied Ferguson's formal report to the Salvesen Company, now part of the Salvesen Archive held by Edinburgh University library. It differs in some details from the preliminary sketches in the notebooks and also from the diagram that accompanied the paper published in the *Transactions of the Royal Society of Edinburgh*. The latter presents a rather more cautious interpretation than the one provided in the Salvesen report, and probably owes its moderation to the influence of Gregory and Tyrrell, who published their own contributions alongside Ferguson's paper.

It is worth remembering that the concept of a vast, foundered South Atlantic continental landmass was the consensus (if not quite unanimous) geological opinion in Ferguson's day. Even some years later, in his 1929 Presidential Address to the Geological Society of London, Gregory still included South Georgia within a Devonian 'Flabellites Land' (so-named after a small fossil shell thought to define its coastline) and both South Georgia and the Falkland Islands within a late Palaeozoic 'Gondwanaland' (named after an indigenous tribe from the Indian sub-continent) that included the entire area of the South Atlantic Ocean (Figure 5). Clearly Gregory was not convinced by Du Toit's 1927 reconstruction, in which the South Atlantic was eliminated and geological links between Africa and South America were emphasised. Du Toit moved the Falkland Islands a considerable distance north to align their geology with that seen in the two, now adjacent continental margins (Ventania, Argentina, and the Cape Province, South Africa). His ideas were much influenced by Wegener's continental drift proposals, but that theory did not gain widespread acceptance until the 1950s.

Perhaps less excusable was the assumption by Ferguson and colleagues, *a priori*, that deformed and indurated rocks must be geologically ancient, so that any evidence to the contrary was ignored or viewed with great suspicion. This was not an unknown

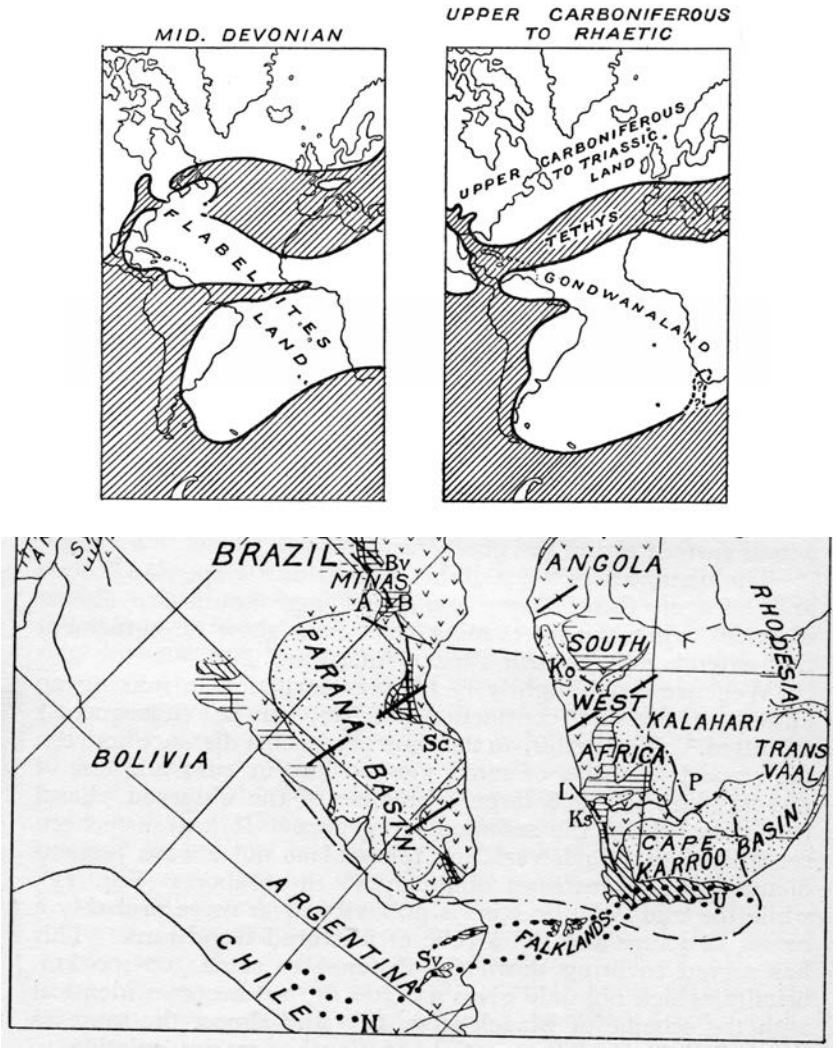

Figure 5. Two contrasting ideas of the geography of the South Atlantic region before the formation of the present-day ocean. Gregory's 1929 view of "Flabellites Land" and "Gondwanaland"(top) is contrasted with Du Toit's 1927 reconfiguration of the South Atlantic region (bottom). Time intervals represented: Gregory's maps – Mid. Devonian = about 390 million years ago, Upper Carboniferous to Rheatic = about 310 to 205 million years ago; Du Toit's map correlates geological features in South America and Africa that formed between the Devonian Period and the opening of the South Atlantic Ocean about 130 million years ago.

problem since the very same issue had been identified long before, in a neighbouring part of the world, by Charles Darwin. When writing in his *Journal of Researches*, first published in 1846, on the geology of Tierra del Fuego which he had visited (along with the Falkland Islands) aboard HMS *Beagle*, Darwin noted that:

"The great clay-slate formation of Tierra del Fuego being Cretaceous … without the evidence afforded by the fossils, would from the analogy of most known districts, probably have been considered as belonging to the Palaeozoic series."

The 'clay-slate' of Tierra del Fuego is broadly analogous to parts of the South Georgia succession, with which it was once in proximity; another quirk of continental drift.

Although many of Ferguson's interpretations have proved erroneous, as an initial gathering of information his work served as a valuable introduction for subsequent investigators. His generally negative conclusions as to the economic potential of the rocks have, however, proved well-founded. In support of his fieldwork Ferguson brought to bear considerable practical skill: under difficult conditions he developed glass photographic plates, prepared thin rock sections for microscope examination and carried out rudimentary chemical analyses of crushed and panned rock samples. He also applied his mine surveying skills when attempting to triangulate the heights of mountain peaks and the distances between them as controls on the thickness of the sedimentary succession that he could see in the exposed crags. Several manuscript maps are preserved in the Salvesen Archive as supplements to Ferguson's formal report to the Salvesen Company; an example from Cumberland Bay (Figure 6) may show the first attempt to measure the height of Mount Paget, South Georgia's highest peak, for which Ferguson calculated 8383 feet; modern measurements give 9629 ft (2934 m). But his work was much constrained by delays and distractions imposed by the whaling business and other circumstances. For example, on 28 February 1912 Ferguson acted as jury foreman at an inquest into the death of Edward Dunn, who had suffered a fatal accident at Leith Harbour on board the *North Sands*; he attended the funeral on the following day.

Despite the shortcomings of Ferguson's work on South Georgia his subsequent collaboration with Tyrrell led to a substantial body of petrographical work that has stood the test of time. Based on the specimens that Ferguson collected, specimens collected subsequently by whalers and sent back to Ferguson, and various other examples collected both prior to Ferguson's visit and by later expeditions, Tyrrell produced a sequence of papers providing unrivalled petrographic detail. In 1930, he made one of the best of the early geological interpretations of South Georgia – even though he never visited the island.

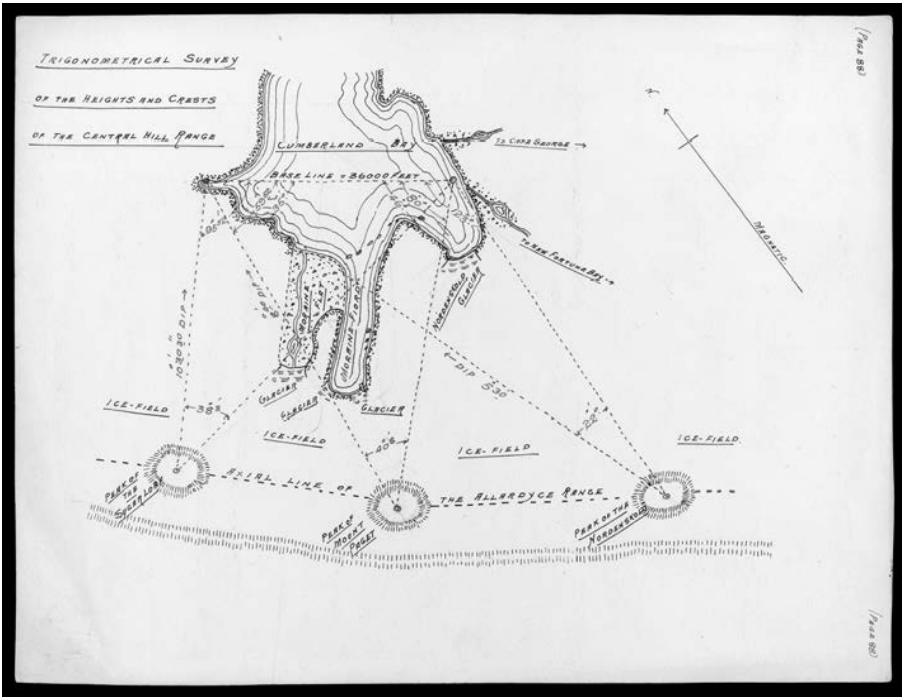

Figure 6. A sketch map of the East Cumberland Bay area drawn by Ferguson and included in his (unpublished) confidential report to the Salvesen Company. Reproduced with permission from Edinburgh University Library, Special Collections Department. Salvesen Archive reference Gen 1925, H34, image reference 25479d.

Whilst working on South Georgia, Ferguson clearly made an impression on the whaling community and was remembered for some time after his departure. When Ludwig Kohl-Larsen (who had been a member of Filchner's expedition) revisited the island during the 1927-1928 austral summer, a location near Leith Harbour was pointed out to him where "an English (*sic*) geologist had found plant fossils". Kohl-Larsen acquired explosives from the whaling station and blasted out a collection of specimens that he passed on to the Senckenberg Museum in Frankfurt, Germany. Today on South Georgia, David Ferguson is celebrated in *Ferguson Peak* (561 m) [54°47'S 35°50'W], a locality in the south-east of the island that was so-named following the topographical survey expeditions of the 1950s (Figure 7).

To conclude this account of David Ferguson's mineral prospecting work around South Georgia a quotation from one of his notebooks, written on 9 March 1912, seems appropriate:

"It was snowing as we dropped anchor in King Edward Cove and blowing strongly occasionally. South Georgia, is a rock bound and storm bound Island at any time, involving considerable danger in getting around it, to examine its geological structure. It is now finished … and I am not sorry that outside prospecting in South Georgia is at an end, so far as I am concerned. It is the toughest job I have had in any experience of 20 years, in various parts of the world."

That sentiment notwithstanding, Ferguson returned in the 1913-1914 austral summer to carry out prospecting work on behalf of the Salvesen Company in the Falkland Islands, South Shetland Islands and the Danco Coast area of Graham Land, as described in the *Falkland Island Journal* for 2013.

Figure 7. One of the authors (PS) near the summit of Ferguson Peak at the south-east end of South Georgia early in 1974. The view looks south-west towards the entrance to Drygalski Fjord. The frost-shattered rock in the foreground lies within the Cooper Bay Shear Zone; more distant are igneous rocks of the Drygalski Fjord and Larsen Harbour complexes.

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Phil Stone
British Geological Survey
Murchison House, West Mains Road, Edinburgh EH14 1JZ

John Faithfull
Hunterian Museum
University of Glasgow, Glasgow G12 8QQ